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SMALL ARMS POWDER MANUFACTURE IN GERMANY

October 1945

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TECHNICAL REPORT No. 271-45

SMALL ARMS POWDER MANUFACTURE IN GERMANY

SUMMARY

The I. G. Farben plant at Rottweil and the DAG plants at Kaufbeuren and Ebenhausen were investigated. The information obtained on small arms powder is recorded in this report.

October 1945

U. S. NAVAL TECHNICAL MISSION IN EUROPE

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SMALL ARMS POWDER MANUFACTURE IN GERMANY

I. Introduction.

Small arms powder, i.e., for pistols, rifles, machine guns and 20 mm guns in the German military forces, was made from nitro-cellulose by the solvent process. The I.G. Farben plant at Rottweil was one of the oldest plants in Germany and was the center for most of the important research and development work in this field. Detailed information was available at Rottweil but capable personnel were not located at the D.A.G. plants at Kaufbeuren and Ebenhausen. For this reason the present report describes the procedures and powders at Rottweil while only a general description of the other plants is presented.

The personnel interrogated were:

Rottweil - Dr. Fink, Chemist in Charge of Powder Plant.

Kaufbeuren - Dr. Benckendorf, Asst. Chief Chemist.

Ebenhausen - Dr. Scheppen, Supt. of N.C. and Acid.

II. Raw Materials.

The raw materials used were as follows:

A. Nitro-cellulose.

B. Diphenylamine.

C. Alcohol and Ether.

D. Graphite.

E. Camphor.

F. Centralite.

G. Pottasium Sulfate.

II. Raw Materials (Cont'd.)

(A.) The nitrocellulose used at Rottweil was made at other plants such as, Troisdorf, Eilenberg near Leipzig, Ebenhausen, and Speyer am Rhein. This material was made from woodpulp. Most powder was made with a nitrocellulose blend of 13.25 percent N_2 composed of about 80 percent of 13.4 percent N_2 and 20 percent of 12.4 percent N_2. It was stated that this blend had a viscosity of 60 to 100 centipoises in a one percent acetone solution.

(B.) Diphenylamine obtained from I.G. Farben factories was added as a stabilizer. About one percent was used.

(C.) It was stated that either ethyl or methyl alcohol was used depending on the availability. Very little difference in operation or quality was observed with such a change. Ether was not made but was obtained from I.G. at Höchst.

Nothing unusual was observed about the other raw materials used. Graphite, camphor and centralite were added as coating materials. The potassium sulfate served as a flash reducing agent and also as the soluble salt which was leeched out in producing porous powder.

Overall average alcohol loss (includes ether equivalent) was .45 kg per kg of powder made,

III. Types of Powder.

Samples of 19 representative powders made at Rottweil were examined. The type, dimensions and the guns in which each was used are listed in the table following this section. The commonest type was the single perforated cylindrical grain. In the table, the dimensions show the diameter and length, generally the same, and the diameter of the perforations. All dimensions are for the dies and pins. Although shrinkage of about 40 percent on the diameter was reported, all powders were classified on the die dimensions rather than the finished grain measurements.

This leads to a discrepancy in diameter and length since the strand from the press was not cut until after the first solvent recovery when the main shrinkage had occurred.

Small squares or plate powder was a second general type. This was extruded as a strip and then cut. No powder rolls were used in making

III. Types of Powder (Cont'd.)

N. C. type powder.

A third general type was the cylindrical grain with no perforation. This rod form was used for some small arms and also for igniter powder made for cannons.

The most unusual type was that made in the form of a "T". Item 12 in the list gives dimensions of a grain with the horizontal part of the "T", 2 mm across, 1.4 mm. long and 0.5 mm thick with the vertical part 1.4 mm long, 0.5 mm high and 0.25 mm thick.

A list of several hundred powders which had been made at Rottweil was furnished, but has not been reproduced. These data will be forwarded with other untranslated documents. The importance of these special and trial sizes with various coatings is considered secondary, especially since ballistic values were not available.

The special powders listed as items 18 and 19 are described in Section VI - Development in this report.

Item	Type	Dimension	Porous	Use
1.	Rohrchen-Pulver 2.5 x 2.5/0.5	2.5 x 2.5/0.5	-	15 mm Mg 151 Sprenggranate
2.	Rohrchen-Pulver 608	3 x 3/0.5	-	2 cm Flak 30/38
3.	Versuchs-Pulver 1 1003 IIa	3 x 2.8/0.5	-	3 cm MK 103 - Flak 3.7 cm
4.	Buchsen-Pulver No.1	2 x 2 x 0.7	-	Kal.6.5 mit 10 g Geschoss, 2 cm MG 151/20 Sprenggranate
5.	Buchsen-Pulver 2	2 x 2 x 0.7	-	Kal.7mm mit 10 g Geschoss 2 cm MG 151/20 M-Geschoss 92 g.
6.	Buchsen-Pulver 3	2 x 2 x 0.5	-	Kal. 7.65 - 13 mm MG 131.
7.	Buchsen-Pulver 4	2 x 2 x 0.45	-	Deutsches Inf. gew 98
8.	Jagd-Blattchen-Pulver 3636	1.7 x 2.3 x 0.4	+	Alle Jagd-Schrot-Patronen
9.	Rohrchen-Pulver 438-c	2 x 2.3/1	+	Wurfgranate 5 m 10 cm.
10.	Platzpatronen-Rohrchen-Pulver94d	1.5 x 1.5/0.75	+	Infant. Platz-patrone
11.	Ring-Scheiben-Pulver 1912	1.2 x 2.5/1.1	+	Scheibenbüchsen, Patr. 8 x 46 mit Bleigeschoss
12.	Flugel-(T)-Pulver 1893	1.4 x 2 x 0.5 x 0.25	+	Gewehrgranate

Table (Cont'd.)

Item	Type	Dimension	Porous	Use
13.	Pistolen-Nudel-Pulver	0.7 x 0.7	+	Alle Pistolen
14.	Nitro-cellulose-Stabchen-Pulver-neuer Art 2708	0.8 x 0.8	+	9 mm Parabellum
15.	Pistolen-Platz-patronen-Nudel-Pulver 1260	0.3 x 0.5	+	Pist. Platzpatronen Zerleger für 15 mm u. 20 mm Granaten
17.	Klein Kaliber Pulver B 39 b	0.3 x 0.7	+	Kleinkaliberpatrone 5.6mm
18.	Niperyth-Rohrchen-Pulver 288	1.8 x 1.3/0.2	-	Inf. Patr. mit SMKH Geschoss 12.8 g 7.9mm MG 81
19.	NSP (Nitrocellulose-Schwarz-Pulver)	1.3 x 1.3	-	Beiladungspulver für Geschütze aus 80% Schwarzpulver und 20% Nc.

III. Types of Powder (Cont'd.)

At Kaufbeuren, most of the production was made on five of the types listed above, i.e., items 2, 7, 16, 18 and 19. A small quantity of multi-perforated (item 7) powder was also made for use in captured Russian 75mm guns.

Detailed information on types of powder made at Ebenhausen was not available but it was stated that the constants were furnished by Rottweil. At Kaufbeuren it was stated that Ebenhausen production was primarily 2cm powder (item 2).

IV. Equipment and Operating Procedures.

The major steps in the manufacture of small arms powders in the German plants visited were as follows, starting with the water-wet nitrocellulose as received:

1. Dehydration.
2. Mixing.
3. Pressing.
4. Solvent Recovery.
5. Activated Carbon Solvent Recovery.
6. Cutting.
7. Water Extraction (Porous Powder).
8. Sieving.
9. Pre-Coating.
10. Vacuum Drying.
11. Coating.
12. Air Drying.
13. Removing Dust.
14. Blending.
15. Packing.
16. Rectifying Alcohol.

Dr. Fink of Rottweil prepared a report describing the equipment and operations. This has been translated as follows:

I. G. ROTTWEIL

1. Building 272 Dehydrating Plant

This plant employs centrifuges exclusively, of the 10 (ten), five

IV. Equipment and Operating Procedures (Cont'd.)

are equipped for electric and five for water-power drive. The electric-driven centrifuges are supplied by Haubold, A.G., Chemnitz and the water-driven machines are supplied by Schonmann & Frohlich in Braunschweig. In front of the building are two pumps for producing high water pressure. In general, it is preferable to use the electric-driven centrifuges, because the speed can be more easily controlled. The capacity of the two types is practically the same.

The charging of the centrifuges is done without weighing, and averages 77 k of moist nitrocellulose = 50 kg of dry in the case of the electrically driven centrifuges, while 84 k of moist nitrocellulose = 55 k of dry in the case of the water-driven centrifuges. A heavy, not completely closed brass ring lies on the bottom of the centrifuges, at the outer wall. The nitrocellulose is filled in sacks, which are emptied into the centrifuges and packed in with a wooden tamper by hand.

The separation follows the scheme shown below:

Electrical Centrifuges	Water-driven Centrifuges
1. Short whirling at 1000 RPM without alcohol.	
2. Return to 100 RPM.	
3. Run in 60 l. alcohol.	
4. 3 ½' at 500 RPM.	) 11' at 1000 RPM.
5. 7' at 1000 RPM.	) -
6. Return to 100 RPM.	
7. Run in 70 l. alcohol.	
8. 3 ½' at 500 RPM	)
9. 6' at 1000 RPM.	) 10' at 1000 RPM.

The entire separation process takes about 45'.

After the centrifuge has stopped a hole is made with a spade in the mass and the ring is pulled out, at which time the entire mass breaks up into a few large pieces, which are easy to remove. The nitrocellulose, moist with alcohol, is loaded into carts and is then weighed into airtight containers, each holding about 12 kg dry weight.

The alcohol upon admission to the machine is of 92-94 percent in the case of ethanol and 88 percent in the case of methanol, while

IV. Equipment and Operating Procedures (Cont'd.)

the alcohol drained off is 85 percent for ethanol and 80 percent for methanol.

2. Building 236 and 292. Mixing.

In both of the above-mentioned buildings are 5 mixers of equal size, built by Werner and Pfleiderer, Cannstatt. The capacity of these is 108 kg dry-weight nitrocellulose per mix.

Composition of mix:

Nitrocellulose:	108 kg) = 166 kg alcohol-moist Nc
Alcohol	58 kg) (with 35 percent alcohol)
Ether	58 kg
Diphenylamine	0.8 kg in 4 1 ether for Bl.P.
	1.2 kg in 6 1 ether for R.P.
K_2SO_4	1 to 2 kg

In the case of porous powders, the addition of KNO_3 up to 30 to 250 percent of the weight of Nc is sometimes done, in which case the quantity of Nc added to the mix must be correspondingly reduced, so that in the case of the powder containing the maximum of KNO_3 only 60 kg of Nc is used.

Ether is added in two portions, and the running time of the mix is from 1 to 1 ½ hours. The temperature rises to about 30° C, and the mixers are cooled with water in summer, but not in winter.

The mixed mass is transferred by tilting the mixer into 8 (eight) airtight containers, so that the contents of one container are about 13.5 kg Nc by dry weight.

One mixer yields 18 x 108 = 1950 kg Nc (by dry weight) .

3. Buildings 286 and 287. Pressing.

In the press building there are 8 presses in the upper story, of which 6 (six) are made by Krupp, Essen, and 2 by Werner Pfleiderer, Cannstatt. The machinery for producing the initial pressure required for loading the cylinder is centrally located, for all presses, in building 287. This space contains two press pumps and one compressor with 4 accumulators and 8 air bottles, designed to give an initial pressure of 60-90 atmospheres. For the actual pressing operation, each press has its own pumps. The press pressure is about 120-150 atmospheres. The velocity of exit of the strings of powder is about 1 m/sec. By keeping the total area of the holes in the dies about constant, this velocity can be kept approximately the same for different types of powder. One press has a 24 hour capacity of about 2000 kg.

4. Solvent Recovery.

After leaving the presses the powder falls through a vertical channel into the pre-driers, which are located on the first story. The string of powder is led through the pre-drier on an endless belt to an automatically operated swinging funnel. Strips of leaf powder are cut automatically into lengths of about 4 meters by a shears just before dropping on the belt. In the case of small tubular powders, the man servicing the machine tears off the bundles periodically. Through the motion of the swinging funnel and the assistance of the machine operator the bundles of powder are hung on horizontal rods in a regular fashion and these rods, propelled by a moving chain mechanism, are then pulled through the drying chamber. This chamber is exhausted from above, while warm air at about 35° to 50° C. is blown in below. After passage through the dryer, which takes about 40', the bundles are dry enough to be cut. (through loss of all but 15 - 20% of solvent).

5. Building 291. Charcoal Absorption.

This building contains 7 (seven) absorption tanks, each containing 5000 kg of absorption charcoal (I.G.-Leverkusen). The solvent charge for each tank is 300-400 kg ether-alcohol. The progress of the absorption is followed by a series of thermometers, each at a different level in the tank. Air containing solvent contains at the most 5 % of solvent vapor, and therefore remains below the limit of explosion danger. The distillation goes from top to bottom, and the solvent-water mixture is freed of ether in the same building. The dilute alcohol is pumped to Building 260. The raw mixture is distilled in a column which has a capacity of 7500 kg of ether per day (24 hours). This column was made by Golzern, Grimma.

IV. Equipment and Operating Procedures (Cont'd.)

The charcoal is dried with warm air (110° - 120° C.)

The times in this operation are, for one tank:

Charging:	30'.
Distillation:	15 - 20'.
Air Drying:	30'.
Air Cooling:	60'.

The absorption system was built by Firma Bamag-Meguin, Berlin, and is of out dated construction, without automatic operation.

6. Cutting.

In building 286 are located 12 (twelve) Krupp cutting machines. The capacity is naturally dependent upon the length of the material to be cut, which varies from 0.3 to 3.0 mm. In the case of normal R.P. one cutter has approximately the same capacity as one press. Building 225 contains one Krause cutter of a less favorable design.

7. Building 261. Washing - Water Extraction.

Eighteen (18) vats are used for washing operations. The heating of these vats is accomplished by direct steam, with the steam line lying under the perforated double bottom of the vat and having its mouth in the center of the vat. The overflow is so arranged that when the water is drained it only drops as far as the surface of the double bottom, so that the steam line is always under water.

The loading of the vats is done while the vats are empty, and each vat receives 110 sacks each containing 12 kg of powder. The vat is then filled with water and the steam is turned on. For thin-walled powders this washing takes 2 x 12 hours, and for thicker walled powders 2 x 18 hours with a single change of water. The temperature is kept at 80° to 85° C. At the end of the washing time, the water is drained, the sacks are allowed to drip, and are then removed without whirling to the drying house.

There are eight (8) smaller vats in this building for the washing of porous powders. These powders are leached out for 6 x 2 hours with condensate water from the KNO_3 recovery plant, or with any other condensate water, in order to avoid fouling of the distilling apparatus.

IV. Equipment and Operating Procedures (Cont'd.)

Each vat has a capacity of 35 sacks of each 12 kg. The KNO_3 solution leached from this washing operation contains from 15 to 40 % KNO_3, depending upon the saltpeter content of the powder. Porous powders are whirled after the washing process.

The concentration of the saltpeter solution resulting from this process is carried out in a still made by Kühnle, Kopp u. Kausch A.G., Frankerthal, which operates in a continuous cycle on a steam pressure of 1.5 atm. The saltpeter solution is concentrated to 55% and is led off to a vat with water-cooling and a stirrer, is brought to crystallization and the crystals separated by whirling. These are dried in a trough drier with a spiral transport, the drier being supplied by Petry & Hecking, Dortmund.

The KNO_3 content of porous powders is about 0.01 - 0.05% after the washing process.

8. Buildings 245, 266, 267, 268, 280, 285, 286. Sorting.

In these buildings the following sorting machines are located:

245 -- 1 Miag (Braunschweig).
266 -- 2 Schenk (Darmstadt).
267 -- 1 Wetzig (Wittemberg).
268 -- 1 Schenk
280 -- 1 Schenk (rebuilt in Rottweil).
285 -- 2 Wetzig, (One of them rebuilt in Rottweil).
286 -- 4 Miag.

The machine located in Bldg. 280 is used for the pre-sorting of powders still containing solvent. The powder runs through the machine once, resulting in about 10% of sorting rejects.

The machines designed by Miag have crank linkage and oscillate the slowest of any, while those of Wetzig and Schenk oscillate free, the Schenk machine having the highest frequency.

9. Building 299. Pre-polishing (Pre-coating).

In this building are located 6 (six) slanted drums and 2 (two) vertical drums, each designed to hold 200 kg of powder. The powder

IV. Equipment and Operating Procedures (Cont'd.)

after leaving the cutting and pre-sorting buildings, contains abot 15% of solvent. For each polishing barrel containing 200 kg of powder there is added at this time 180 g (for leaf powder) and 90 g. (for tubular powder) of graphite and 0.1 to 0.2% of Centralit IV (N-Ethyl-Phenyl, and N-Ethyl-Tolyl-Urea) dissolved in 2-4 l. of ethyl alcohol. The polishing drum is run for 30 minutes.

Building 300. Solution Preparation.

In this building there are two heated tanks for the preparation of the aforementioned solution used in the pre-polishing process. Each tank holds 50 liters.

10. Buildings 249, 250. Vacuum Drying Chambers.

In building 249 there are 6 (six) large chambers for 1100 kg powder each and 2 (two) small chambers for 650 kg powder each. In Building 250 there are 8 (eight) small chambers for 650 kg. powder each.

The powder which has been loaded into trays in building 240 is dried for 20 hours in the chambers, the water temperature in the heating plates being kept at 72° C. The vacuum is held 650 mm. of mercury, or 60-70 mm absolute. Powder enters the driers with about 10-15% of solvent and leaves them with 0.5 to 1%. Porous powders are not dried in vacuum chambers.

Building 255. Solvent Tanks.

In this building are located 5 tanks with stirring apparatus for making the diphenylamine solution. The tanks are charged with the following:

500 l. Ether.
45 l. Alcohol.
110 kg. Diphenylamine.

11. Buildings 195 and 246. Coating.

195.- 4 large coating drums and 8 small coating drums, of which 8 have recovery systems - 4 are not heated.

IV. Equipment and Operating Procedures (Cont'd.)

246 - 3 large and 10 small coating drums, of which 8 have recovery systems - two of these are not heated.

The small drums are charged with 170 kg of powder and 90 kg of wooden balls, and the large drums with 340 kg powder and 180 kg of balls. In the coating process, the drums are set in motion after adding 160-180 grams of graphite, at a rate of 18-20 RPM, and in the case of Bl.P. two liters of water. The drum is run warm for 2 (two) hours.

Centralit I is used on all powders, sometimes in conjunction with Diamylphthalate (Amylol) or camphor. The amount of Centralit used varies with the powder from 1 - 5.5%, for example:

For a coating with 4.2% of Centralit I (Bl.P. 2 x 2 x 0.7) a coating of 3% of Centralit is applied in the first treatment, and of 1.2% in a second coating. The entire material used for the process is dissolved previously in alcohol, the 3% Centralit for the first treatment in 8 l./% = 13.6 l. alcohol, and the 1.2% Centralit for the second treatment in 4 l./% = 6.8 l. alcohol, the entire amount of centralit, therefore, (= 7.14 kg) in 20.4 l. alcohol.

The first coating takes place in four installments of each ¼ of the amount of solution to be used, and the second coating in two installments. After the injection of each installment the drum is run for 45'. After the first coating the drums are run for 1 hour, of which the last fifteen minutes the batch is run with a small partly opened cover on the drum. With each installment of liquid 80 g. of graphite are added. At the end of the operation the drums are run for 1 hour with the cover off completely. In the case of the drums with recovery system installed, naturally the opening of the cover does not take place. These drums are filled through the round opening in the middle of the front side, if they are not equipped with recovery systems, if they are so equipped, they are filled through the square opening in the outer covering, through which the emptying is also accomplished.

All figures given here apply to the small drums.

The entire coating process takes 6 (six) hours, with the temperature held from 50° to 55° C. There are several heated tanks in these two buildings used for the making-up of the solutions used in the process, with contents from 50-100 liters. In the drums with recovery systems the alcohol recovered is about 50% of that used, and is in the form of 92-94% alcohol.

IV. Equipment and Operating Procedures (Cont'd.)

12. Buildings 197, 302 and 306. Air Drying Houses.

Buildings 197 and 306 are designed for drying in sacks, while Building 302 is intended for drying in trays.

In Building 197 there are 10 (ten) chests with screen bottoms, through which warm air generated in the cellar is blown. The powder is laid in these chests in several layers in the washing sacks. About 55,000 m^3/hour of warm air is used for the drying, at a temperature of 60° to 65° C. The drying takes about 12 hours, after which cold air is blown in for cooling purposes. The building is capable of taking 3000 kg. of porous powder or 5000 kg. of non-porous powder. Because of the solid construction and elevated location of this building, porous powders are dried exclusively in this building.

The installation in Building 306 is mechanically similar to the one described, but is of older construction and has less efficiency. There are 2 rooms with 8 (eight) chests each located on two floors. The charge per chest is 500 kg., therefore the capacity of the building is 8000 kg.

In Building 302 the powder is shaken out of the sacks in the entryway into aluminum trays. These are set up in 10 (ten) chambers, each divided into 8 portions and these in turn with each 12 (twelve) levels. Air at 65° C. enters from one side of the chambers and is blown over the trays. The capacity of the installation is 10,000 kg. of powder. The drying time for non-porous powders, including the cooling time, is 24 hours. Because it is necessary to shake the powder twice during the drying process, this drying house has only been used in emergencies in recent times.

13. Building 304. Dust Removal Cylinders.

There are in this building 2 (two) dust removal cylinders, whose purpose is to remove the graphite and powder dust from the powder before the mixing. One cylinder is used for porous powders, while the other one is used for non-porous types. The apparatus, built by Miag of Braunschweig, consists of a six-sided tilted cylinder with screen walls. The powder travels through the cylinder, while air is being blown through it. The equipment has a capacity of about 600 kg of non-porous powder/hour/cylinder.

IV. Equipment and Operating Procedures (Cont'd.)

Building 311. Nitrocellulose Storage (Silo).

In the old building there is a silo used for the storage of unpacked nitrocellulose. This is built completely of wood, stands on pilings, and is lined inside with sheet Mipolam, or polyvinyl chloride. All cracks are sealed with cement. The flooring of the silo is in the form of an inverted gable, so that the silo can be emptied completely and rapidly in emergencies. The emptying is accomplished by the simultaneous release of the two sides of the flooring. A sprinkler system is installed in the roof so that the nitrocellulose can be wet down if necessary. The entire silo is divided into 11 (eleven) parts of equal size, and the entire building holds 100,000 kg of nitrocellulose, dry weight. This installation has proven to be very satisfactory in every respect.

14. Building 296. Blending House.

A blending tower is used exclusively for the purposes of powder blending. In this tower, the powder is brought together twice, and then spread out on a cone. At the same time dust is being removed by means of an air blast. For filling the blender, 8 (eight) bins are used, whose exits can be opened simultaneously, and each exit diameter individually regulated. In all, 1600 kg. of powder can be blended at one time. The powder run-off is through a canvas tube at the bottom of the tower - this can be shut off or opened by hand. The powder coming from the machine is weighed into sacks containing about 40 kg. An elevator carries material up to the upper story of the building.

If an order for 25,000 kg of powder is to be filled, first a test blending of 16 sacks of powder (640 kg) is made by a triple blending in the machine and this is tested ballistically. If this proves correct, or can be easily corrected, a larger batch of 40 (forty) sacks = 1600 kg of powder is blended and called the "Special Blending". A "Main Blending" consists of 4 (four) special blendings = 6400 kg. of powder, and 4 (four) such main blendings fill an order for 25,000 kg. of powder. An order like that just described can be prepared in 8 hours.

15. Building 294. Packing.

The powder coming fro: the blending process in Building 296 is

IV. Equipment and Operating Procedures (Cont'd.)

shaken into a filling funnel and slides down to the "polishing-mill", a screen shaken by hand, in which gross impurities are screened out and blown away by an air blast. The powder then falls into tared vats which are passed on by hand and are filled to exact weight on scales. The contents of the vats are transferred to the packages, which are carried out of the packing room and sealed on the ramp outside.

16. Building 260. Spirit Rectification.

In this building are located 1 (one) alcohol and 1 (one) ether distilling column, both designed for continuous operation, built by Golzern-Grimma, also three old glass distilling systems with columns, built by Heckman of Breslau.

The alcohol distilling apparatus handles all the material coming from the centrifugal separators as well as from the charcoal absorbing apparatus. This column has a capacity of 15,000 liters/24 hours.

The ether distilling column has a capacity of 3000 kg/24 hours, but is not generally used.

The glass stills are only used as auxiliaries, for example to handle the alcohol which comes from the coating drums equipped with alcohol-recovery systems.

Besides the stills, there is an extraction apparatus in this building used to recover Centralit and camphor from powder droppings before these are used again. The equipment is no longer in use, although the first experiments with it were made with a charge of 100 kg of powder, extracted for ½ hour with ethanol.

Rottweil, as the center of small arms powder development, frequently sent representatives to all of the other German plants making this same product. From study of several reports of such visits, it is concluded that the equipment and procedure at the plants operated by WASAG and Wolff and Co. were quite similar to those at the DAG plants with only minor exceptions. Some of these are described below.

Pictures showing the dehydrating centrifuges, and the powder presses at Kaufbeuren are in the Appendix. Attention is called to

IV. Equipment and Operating Procedures (Cont'd.)

the dual cylinder of the press. One side was used as a block press while the other was used for extrusion.

A sketch of the die plates and pin holders used for the single perforated grains is also shown in the Appendix.

Also shown is a Reinsdorf (WASAG) sketch showing a cutter installed just under the die on a press for perforated grains.

A sketch of the Reinsdorf blending equipment shows the use of only one compartment. At Rottweil the powder was taken to the top of the tower in bags on an elevator. It was dropped from the eight compartments into a cone, then down the surface of an inverted cone, into a second cone. There were three inverted cones and two vertical. The lowest cone was discharged through a gate valve to a bag.

V. Testing.

The ballistic laboratories of the plants visited had been dismantled or destroyed so that observation was not possible. It was stated that the powders were tested in rifle and machine guns up to 2 cm. with conventional Boulanger equipment. Those were standardized with a pendulum.

VI. Developments.

Two recent new powders are described. One contained PETN and was called Niperyth (Nipirit). The other was powder made for the igniter charge in cannons. It contained black powder and was termed N.S.P.

The Niperyth powder was developed for the 7.9 mm machine gun. It was made by the procedure for small arms powder described, at the several DAG plants and also at the WASAG and Wolff plants. At Kaufbeuren it was stated that production of this powder was stopped in October 1944 because of excessive pressures in the guns when it was used.

The N.S.P. powder was developed in cooperation with the Duneberg plant of DAG. It contained 80% black powder and 20 percent nitrocellulose. (cf Technical Report No. 259-45). The N.C. was 12.4 to 12.6 percent N_2 material colloided with ether-alcohol.

VI. Developments (Cont'd.)

Extensive research had been conducted on the effect of the properties of nitro-cellulose on small arms powder. This was primarily a study of variations of cellulose source, nitrogen content and viscosity. The present properties were considered to be near optimum.

Experiments on flash suppression and smokelessness were also conducted over the years. Best results were obtained with about one percent $K_2 SO_4$. It was stated that recent results showed that small plate powder had less flash and less temperature coefficient of burning than the cylindrical grains used.

At Ebenhausen a small pilot plant had been operated to develop a continuous process for manufacturing of nitrocellulose powder by the solvent process.

Unfortunately this building had been destroyed by fire and bombing and detailed information was not available since it had been developed secretly. Observation indicated that the process depended on screw presses for mixing and extruding the powder continuously.

VII. German Small Arms Plants.

It was stated by Dir. Schindler of DAG that the following plants were the most important producers of small arms powders.

Dynamit A. G. (DAG)

Rottweil
Kaufbeuren
Ebenhausen
Aschau

Westfalische Anhaltishe Sprengstoff A.G. (WASAG)

Reinsdorf
Moschwig

Wolff and Co. (Also Eibia)

Walsrode
Döverden

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APPENDIX A

I. Photographs.

Fig. 1. Kaufbeuren Dehydration Centrifuges.

Fig. 2. Kaufbeuren Extrusion Press.

Fig. 3. Kaufbeuren Extrusion Press.

Fig. 4. Ebenhausen Blender House.

II. Sketches.

Plate I. Rottweil and Moschwig Die and Pin Plate.

Plate II. Reinsdorf Die and Pin Plate.

Plate III. Reinsdorf Cutter and Die and Pin Plate.

Plate IV. Reinsdorf Blender.

Figure 1 - Kaufbeuren Dehydration Centrifuges.

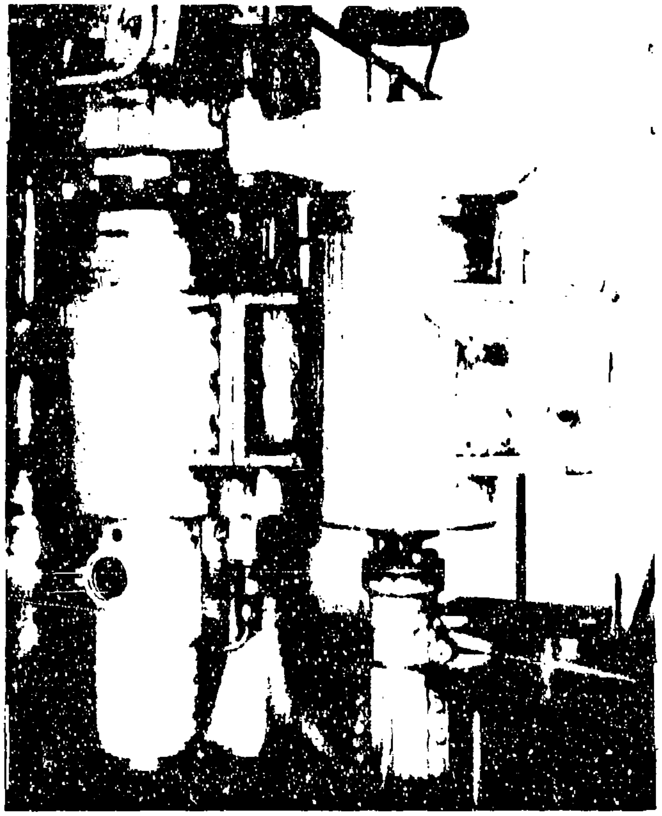


Figure 2 - Kaufbeuren Extrusion Press.

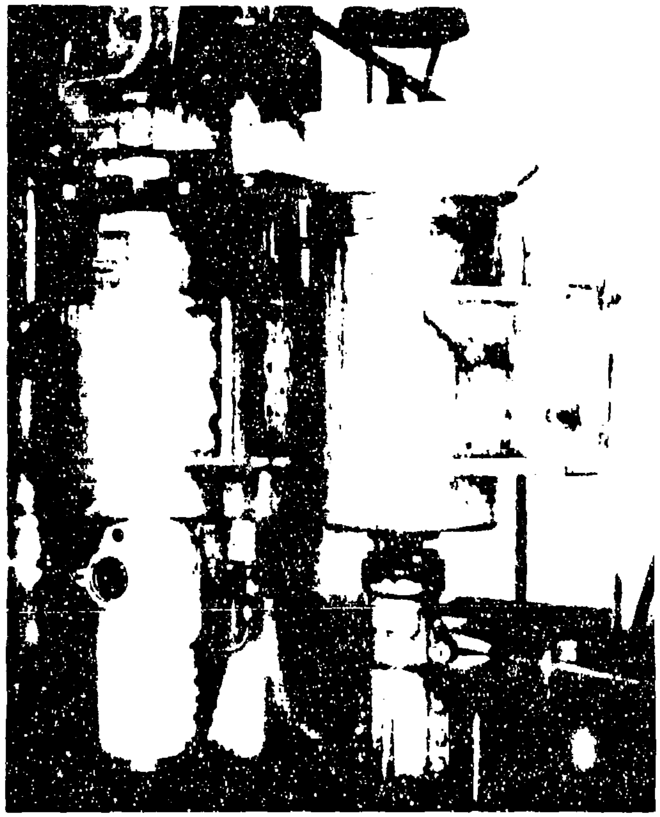


Figure 3 - Kaufbeuren Extrusion Press.

(Another View)

Figure 4 - Ebenhausen Blender House.

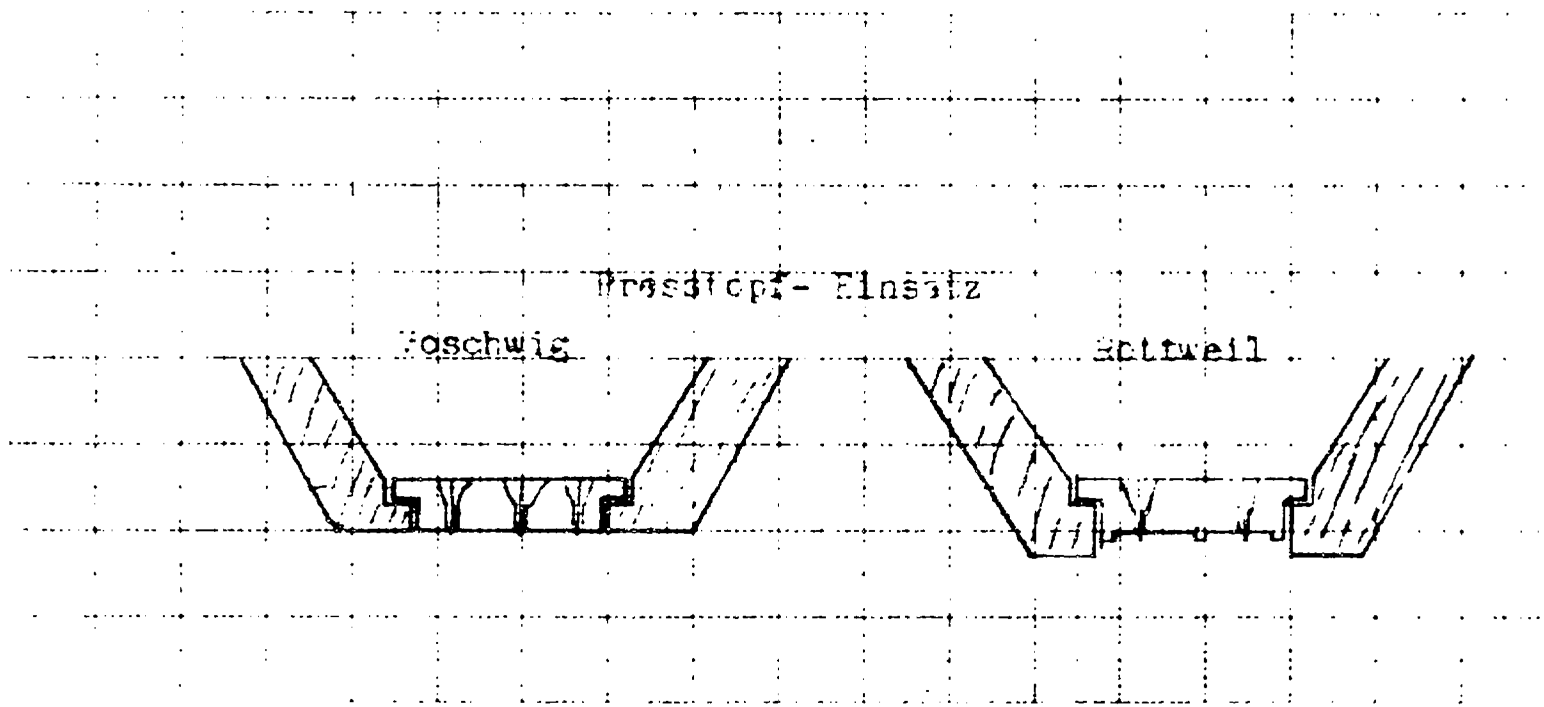


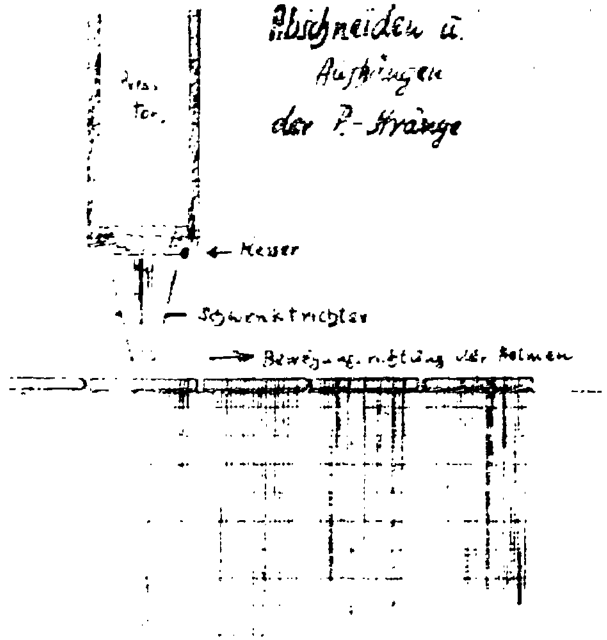
PLATE I

Rottweil and Moschwig

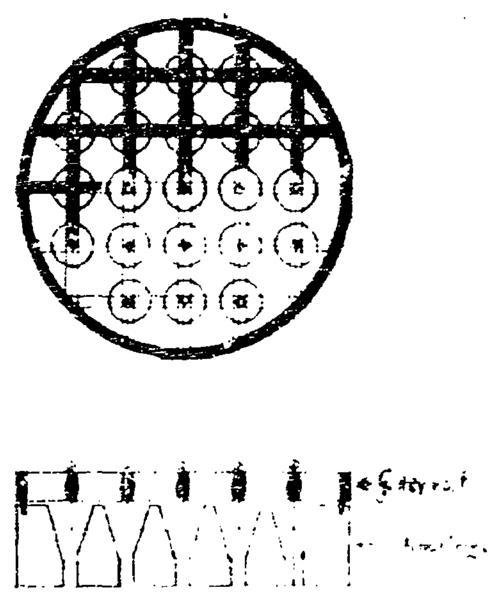
Die and Pin Plate

Reinsdorf

Gitter-Matrize für R.P.



Skizze 2



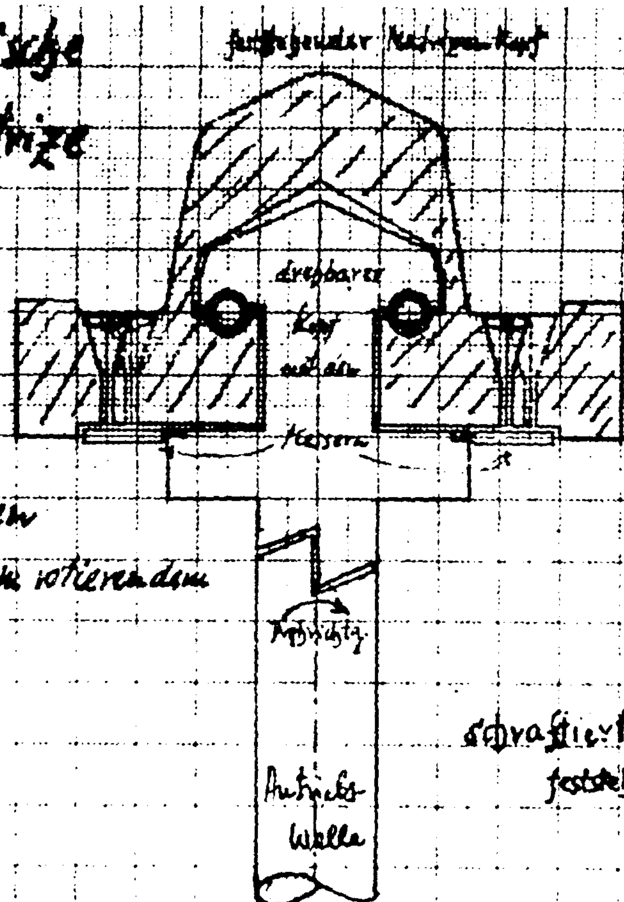
Skizze 1

27.1.43

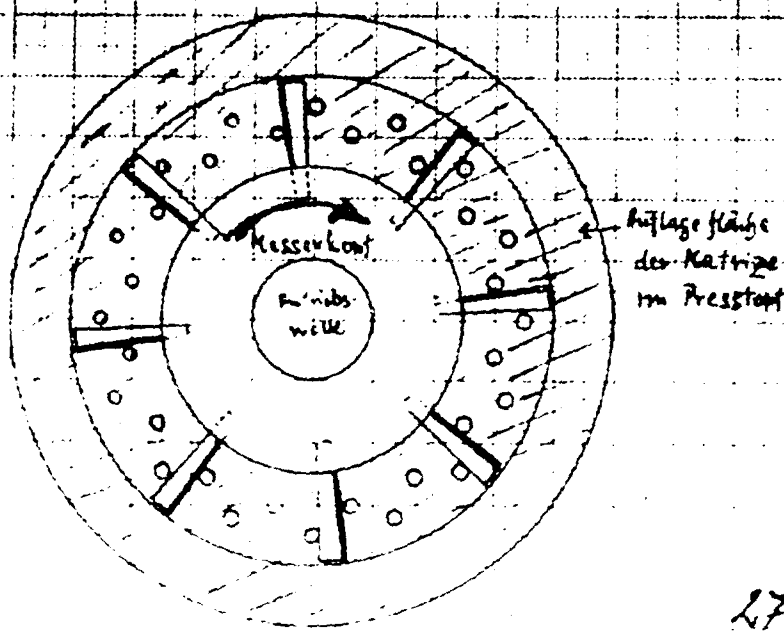
PLATE II
Reinsdorf Die and
Pin Plate

Französische R.P.-Matrize

mit von unten angetriebenem rotierendem Messerkopf.



schraffiert: feststehender Teil

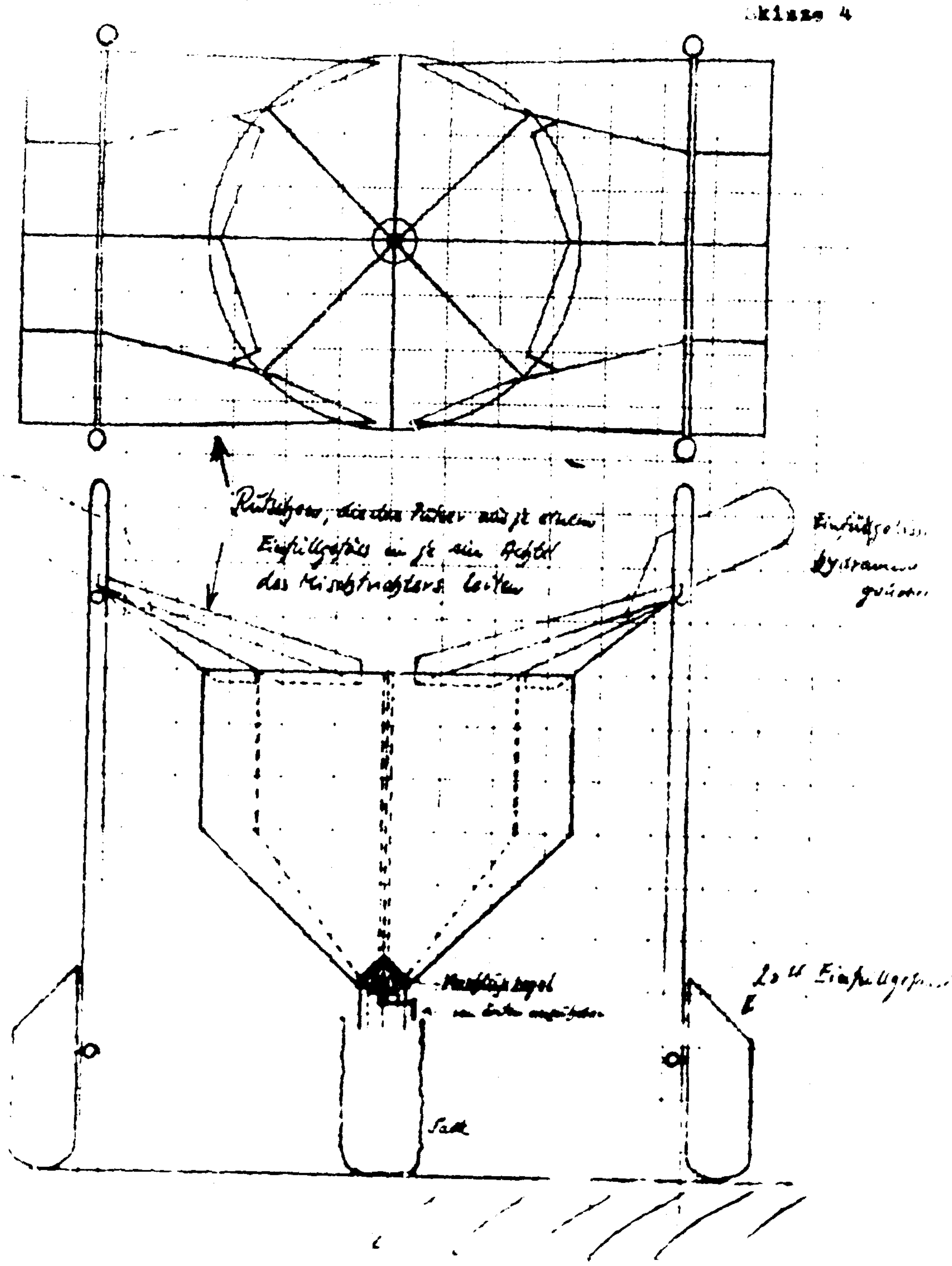


Matrize von unten gesehen

[illegible]

27.1.43

Mel.


Rutschen, die das Pulver aus je einem Einfüllgefäss in je ein Achtel des Mischtrichters leiten
Sack

APPENDIX B

General Information on Plants.

Rottweil was one of the oldest explosives plants in Germany, being one of the first black powder plants. (15th century). It was one of the earliest plants to manufacture nitro-cellulose powders. In 1940 a memorial book was published on completion on 50 years operation. In 1926 the company was absorbed and operated as a unit of I.G. Farben.

During World War I, the plant was stated to have produced 75 percent of the small arms powder used by the German Army. Since then the nitro-cellulose facilities were dismantled and the capacity was not rebuilt. From 1939 to 1945 the average capacity was about 300 metric tons per month. Between the wars about 700 to 1000 lbs a day of sporting powder was made. Most of the facilities had been converted to the manufacture of artificial silk (viscose).

The plant was located in a deep valley with numerous trees between all buildings. Special provisions for camouflage were not taken. The plant had not been bombed.

This plant was the center for development work on German small arms powder. There was good exchange of know-how with the plants of the other firms. Several of the other plant managers had been employees at Rottweil before the war time expansions.

This plant had a serious explosion in 1942 when a mixer house exploded. The house was located in a deep draw and the explosive wave traveled down to the next buildings. A total of 13 persons were killed.

Kaufbeuren was built in the 1940 expansion program. It was a modern plant with the conventional German plant (DAG) camouflage provisions of grass and trees on the roof. (cf Technical Report No. 267-45).

Operations started in April 1943 and the last production was made on April 18, 1945.

Appendix B (Cont'd.)

The maximum production was attained in November 1944 when 124 metric tons were made.

All nitro-cellulose was received from Ebenhausen.

Most of the rifle powder made was shipped to the Army loading plant at Kleinbodungen in Northern Germany. Machine gun powder went to Leipzig and the multi-perforated powder to Olan and Strasse.

The equipment and procedures were almost exactly the same as at Rottweil.

Also located at Kaufbeuren was a small loading company - Sprengstoffe Versuchs Gesellschaft. This firm was building new units for loading TNT and RDX in grenades, demolition blocks and shaped charge munitions. No personnel or detailed information of this company was available.

Ebenhausen was built before 1914 and was expanded during World War I. It was equipped with facilities for nitro-cellulose manufacture, waste acid denitration, nitric acid and sulfuric acid concentration as well as the powder area.

These units were quite similar to the DAG plants at Krümmel (cf Technical Report No. 258-45). One development was noteworthy. This was the practice of washing the N.C. while still in the nitrator house centrifuge with the successive synthetic waste acids of decreasing nitric contents. In this way the nitric loss was reduced.

The N.C. capacity was about 800 metric tons per month. This was shipped to Rottweil, Kaufbeuren, Aschau and Kraiburg plants. The NC powder capacity was about 150 metric tons per month.

About 50 percent of the plant buildings had been destroyed by bombing.